

WBS 1.1 Structural Components (EBIS, LEBT, External Sources)

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1. Superconducting solenoid

Will be purchased from the outside vendor, possibly American Magnetics Inc.

Needs to be done at BNL:

- Finalize requirements,
- Final assessing of magnetic field,
- Inspection, installation, safety review.

Procurement: \$328,299

Base for the cost: 2005 Quote from American Magnetic Inc.

2. Electron gun

Provides:

- $I_{el}=20$ A
- $j_{\text{emission}}=35$ A/cm²
- Operation in a wide range of current, voltage and magnetic field
- Versatility (variable electron beam profile and perveance)
- Maintainability (robust design, ***replaceable unit***)

Degree of readiness of the electron gun:

Has been done:

- Simulated electron beam extraction and propagation in anode and first drift tubes,
- The mechanical design of the gun is nearly complete

Needs to be done:

- Final simulations with final magnetic field,
- Procurements, manufacturing, testing.

Required resources:

Procurements ('05\$): \$53,000

Manpower: \$53,899

Base for estimate:

Quote for cathodes from BINP
(Novosibirsk), catalogs.

3. Drift tube structure

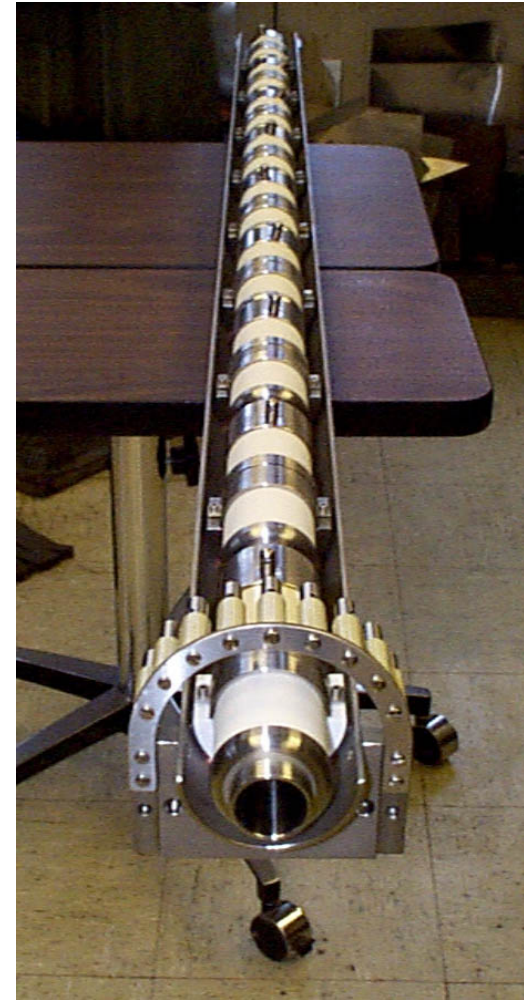
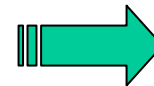
Proposed DT structure:

- Larger ID of drift tubes (42 mm instead of existing 31mm),
- Internal pumping capability (NEGs) for better vacuum,
- Design is based on existing design and experience.

We have conceptual design and assembly drawing

Procurements ('05\$): \$80,000

Base for estimate: cost of existing structure
(Historical cost)

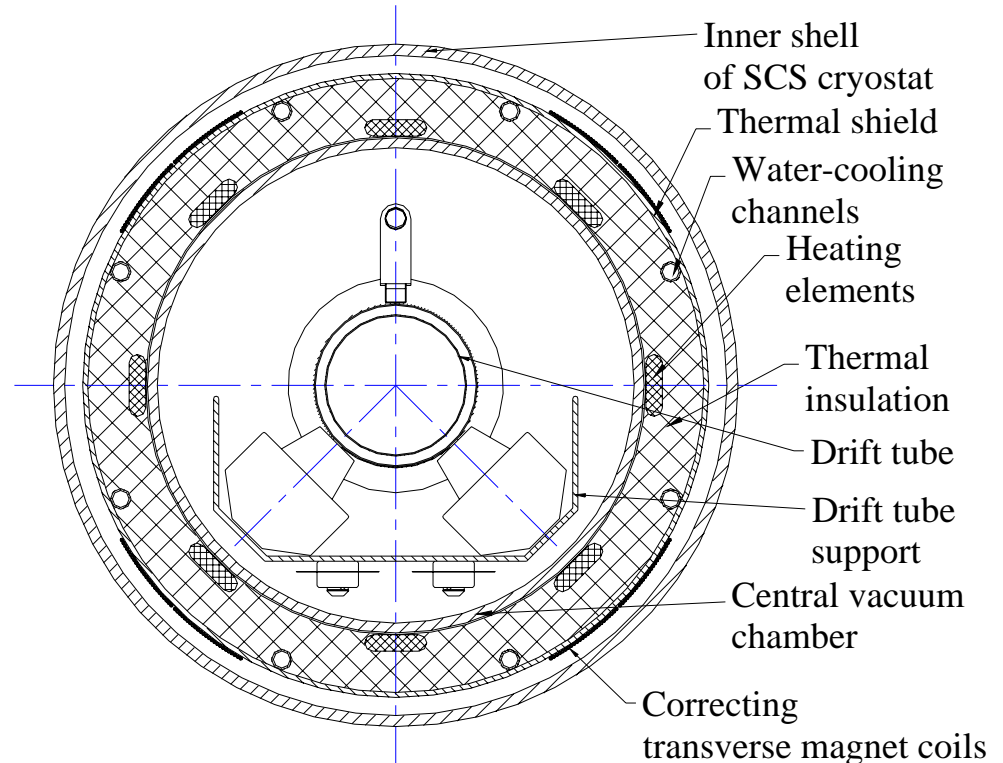


4. Central chamber with its heater

Provides:

- Housing for drift tubes and HV leads,
- Bakeout and magnetic steering of the electron beam

We have: assembly design based on EBTS prototype, technology “know how”.



Procurements ('05\$): \$20,000

Base for estimate: catalogs, prototype cost.

5. Collector-transition chamber

Provides:

- Part of electro- and magneto-optical structure between central chamber and electron collector
- Vacuum separation between electron collector and central chamber
- Vacuum pumping and monitoring
- HV drift tubes connections
- Electron beam loss monitoring

Design is based on using standard elements.

We have: assembly drawing and vacuum separation design, design & technology of magnet coil, prototype “know how”.

Procurements ('05\$): \$15,442

Base for estimate: MDC, ISI catalogs, engineering judgment.

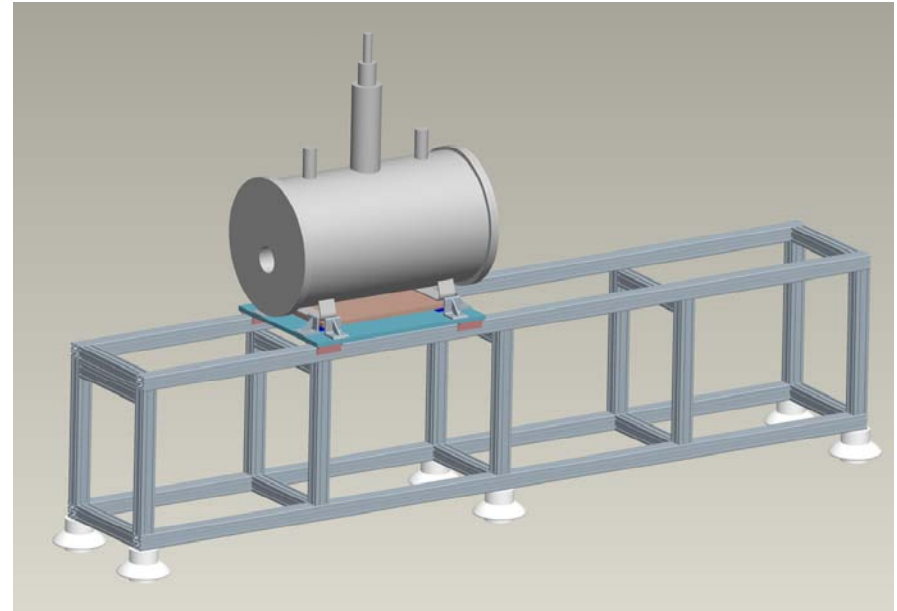
6. Stands, Platform hardware

Includes:

- Stands,
- Manifolds,
- Fast ion extraction unit,
- Transverse coils.

Provides:

- Support of major EBIS parts,
- HV insulation,
- Cooling water and pressurized air distribution,
- Controlled high speed ion extraction,
- Magnetic control of electron beam propagation



6. Stands, Platform hardware

We have: EBTS prototype design of supports, and manifolds, prototype of fast extraction unit.

Required resources:

Procurements ('05\$): \$85,000

Manpower: \$103,402

Base for estimate: engineering judgment

7. LEBT

Provides:

- Transport of the beam of highly charged ions extracted from EBIS to the RFQ
- Transport of the primary ion beam from an auxiliary ion source to EBIS
- Transport of the deuteron beams from additional ion source to the RFQ
- Ion beam diagnostics.

7. LEBT

We have:

- Preliminary optical simulation of the ion extraction from EBIS and propagation in LEBT structure,
- A version of mechanical design with assembly drawing.

Required resources:

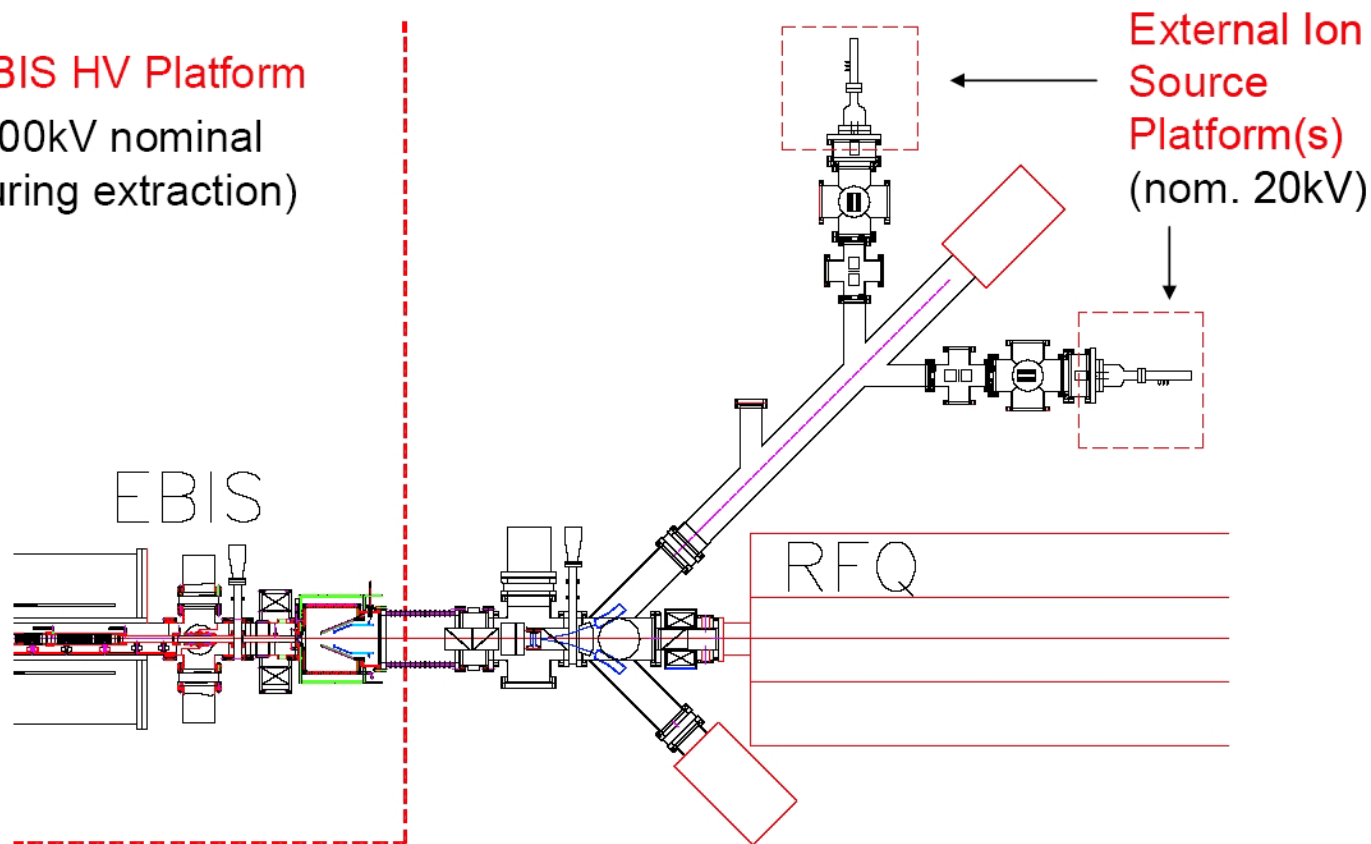
Procurements ('05\$): \$82,000

Manpower: \$66,237

Base for estimate: Quote for accelerating tube from BINP (Novosibirsk), catalogs, engineering judgment.

8. External ion injection

EBIS HV Platform
(100kV nominal
during extraction)



8. External ion injection

Provides:

- Primary beams of low charged ions for injection into EBIS,
- Transport of primary ions to LEBT,
- Control of used ion source or selection of ion species,
- Vacuum pumping with vacuum separation.

We have:

- Developed versions of hollow cathode ion source and LEVA,
- Developed methods of mass-separation, vacuum separation and pumping.

Required resources:

Procurements ('05\$): \$75,554

Manpower: \$63,802

Base for estimate: catalogs, engineering judgment.

9. Electron collector (R&D)

Provides:

- Controlled dissipation of the electron beam,
- Heat removal from electron beam power,
- Ion beam extraction, transport and injection,
- Vacuum pumping.

We have:

- Optical simulations of electron and ion beam transmission,
- Thermal, hydraulic, stress simulations, critical power density and fatigue analysis,
- Mechanical design with design review.

This will be procured/fabricated as part of the R&D, but will later be used on the final EBIS.

Risk assessment

| Components | Risk | Mitigations |
|--------------------------|--|--------------------------------|
| Electron gun | Low | |
| Electron collector | Technical (advanced materials and technologies) | Early procurement, test in R&D |
| Superconducting solenoid | Cost | 40% contingency |
| LEBT | Technical (still in design & simulation stage) | Test in R&D |

WBS 1.1 Structural Components

Estimated Cost

| WBS | Description | Direct FY'05K\$ | | | |
|-----|--------------------------|-----------------|-------|-------------|-------|
| | | Mat'l | Labor | Contingency | Total |
| 1.1 | Structural Components | 1675 | 680 | \$665 (28%) | 3020 |
| | EBIS, LEPT, external inj | 770 | 480 | \$320 (26%) | 1570 |
| | RFQ, Linac, Bunchers | 905 | 200 | \$345 (31%) | 1450 |

Labor hours/equivalents

| | EBIS, LEPT, external inj |
|------------------------------|-----------------------------|
| Resource Category | estimated hours |
| Scientist | 1,760 |
| Engineer | 2,255 |
| Designer | 5 |
| Technician | 2,540 |
| Management | 275 |
| Building Trades | 50 |
| Total | 6885 |
| Full Time Equivalents | 3.9 |

- Design of all components of RHIC EBIS is based on tested design of similar components of the Test EBIS, with improvements in reliability, maintainability, vacuum quality.
- Most of RHIC EBIS components are in an advanced design stage with simulations and calculations mostly done.
- For prototypes of the most critical components (electron collector, LEBT) R&D study is planned in advance of final manufacturing.